



An Introduction to Residential Gateways

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Introduction

In the connected home the user has unprecedented control over their environment with fantastic capabilities such as being able to turn on the floor heating while traveling home from the office, stream video from surveillance cameras in the baby's room or front entrance to a PDA or smart phone, and quickly set the PVR remotely to record a breaking news broadcast as they pass by an electronics shop window littered with TV screens. In this environment, dozens of microcontrollers and switches are manipulated and operated remotely to create an environment that intelligently responds to the user's needs and preferences.

For years the connected home has been the ideal of the world's top consumer electronics, construction and industrial design organizations; each contributing vast resources to the development of protocols, standards and methods that enable their own connected home products to operate effectively. The resulting diversity in operating standards gives rise to immense challenges in bringing every device in the connected home under the control of a single master system that is compatible not only with other connected home devices, but also with standard x86 protocols that enable remote operation via the existing PC infrastructure.

This paper introduces the Residential Gateway from HogarDigital that combines the fanless VIA Eden Platform with market leading software to enable a single home automation system that controls the various devices in the connected home. With its ultra low power consumption, rich levels of integration and x86 architecture, the VIA Eden Platform provides the essential link to the Internet and the vast resources of existing hardware and software that can be used to interface between the user and the connected home. Additionally, the fanless VIA Eden Platform delivers unmatched reliability by reducing the number of moving parts in the Residential Gateway, while offering maximum design flexibility for stylish, aesthetically pleasing systems that compliment the elegant lifestyle of the discerning consumer.



The Philosophy Behind Residential Gateways

Residential Gateways are defined as intelligent network interface devices located at the consumer premises that allow residents to access Internet services delivered to the home while also accessing the different services offered by various smart devices located in and around the premises. This entails **connecting devices to each other** within the home and also **connecting networked devices to other networks and services** outside of the connected home.

Connecting Devices to Each Other (via LAN)

Many homes and small businesses use more than one personal computer in addition to a variety of peripheral devices such as printers and scanners. A gateway connects devices to help users store, share, and protect information within a home or small business network where, for example, family members can store items such as photos, videos, music, and schedules on a gateway device to share the files with others. Some gateways provide advanced authentication and user-preference features that enable users to access personal collections of content, such as favorite music and photos, from any device connected to the network or even from the Internet.

Connecting Networked Devices to Other Networks and Services (via WAN)

Gateways enable users not only to connect devices to each other, but also to simultaneously connect their devices to public and private networks. Having access to the network infrastructure allows users to access a broad variety of remote applications and services. For example, users can reserve airline tickets over the Internet or shop online, employees can access corporate e-mail from home and mobile devices, and homeowners can remotely access automated home control systems while at work or on vacation.

Types of Residential Gateways

Gateway devices are commonly divided into the following three functional categories, or any combination of these three:

Data Gateways

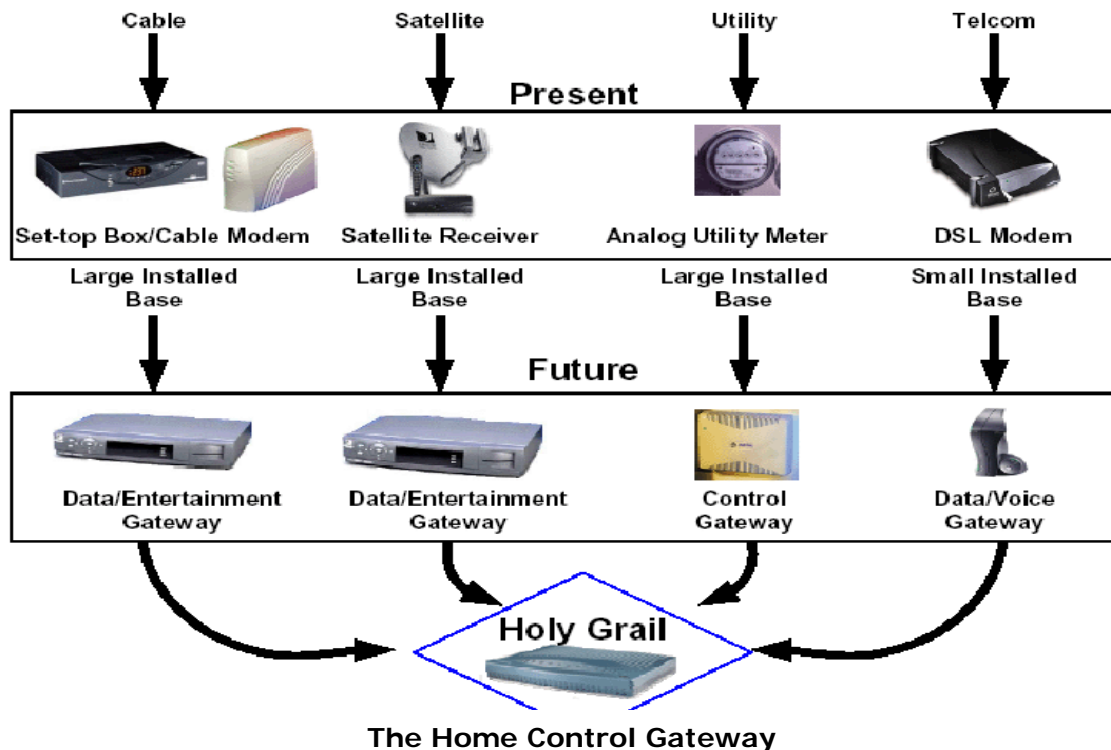
Data Gateways are simple routers primarily used for data throughput. They provide pass-through support for network protocols and services and typically support both wired and wireless networking. Data gateways can be used to pool multiple Internet connections and secure private networks via a firewall. Some data gateways may also provide storage, such as e-mail and voice mail storage.

Multimedia Gateways

In addition to data gateway features, Multimedia Gateways provide features targeted at audio and video content delivery. Multimedia gateways are often used in conjunction with digital entertainment devices (including TVs, stereo systems, and gaming consoles) and can provide centralized storage, acting as a home server for digital media, such as photos, videos, MP3 files, and Web site hosting. Audio and video streaming are important features in an entertainment gateway because they enable users to subscribe to Web-based services such as Video-On-Demand (VOD) and VoIP telephony features. Multimedia gateways also typically include encoding capabilities that transcode analog audio and video signals so users can enjoy media such as cable TV on a range of stylish displays.

Home Control Gateway

Home Control Gateways enable home control and security service management over a network so that, for example, users can access automated lighting, heating, and security systems via the Internet from work or while on vacation. Home control gateways also allow network service providers to offer new packages and generate new revenue streams by, for example, providing energy consumption patterns and information such as time-of-day usage pricing through an affiliate relationship with local utility service providers.



Bringing the Pieces Together

As the central command center of the connected home, the Residential Gateway has the enormous task of merging the various technologies relating to broadband networking, home networking, home automation, home entertainment and a range of PC hardware and software with varying degrees of compatibility.

Broadband Networking

Broadband Internet Gateways provide a bridge between home networks and the vast resources and services available from the Internet. Traditional broadband modem devices can combine home networking hardware and software functionality so as to perform the role of a residential gateway. In fact, most new broadband modems in the market have home networking functionality and hence classify as data gateway devices. Common home networking options include wireless LANs, Home PNAs, 4 port Ethernet switches, home plug, and others.



These Broadband Gateways bring the Internet to households through a variety of technologies such as cable modems, DSL modems or fixed wireless modems. More information about Broadband Internet Gateways is available in Appendix I.

Home Networking

Broadband home networks can operate over a range of physical media that can be organized into three broad groups:

- a. Structured wiring requires installing new cabling in the walls. Both the cabling (typically unshielded twisted pair [UTP] or fiber) and its installation are defined by standards
- b. Existing wiring makes use of electrical, telephone, or coax wiring already installed in the walls
- c. Wireless avoids the use of wires by transmitting through the air



More information about home networking is available in Appendix II.

Home Automation

Due to the lack of communications protocols in the early days of home automation, consumer appliance and industrial manufacturers opted for proprietary rather than standardized solutions for their new electronics products. As a result, compatibility between products and home automation elements (sensors, actuators, telephone gateways, etc...) has been a major hurdle for the connected home industry.

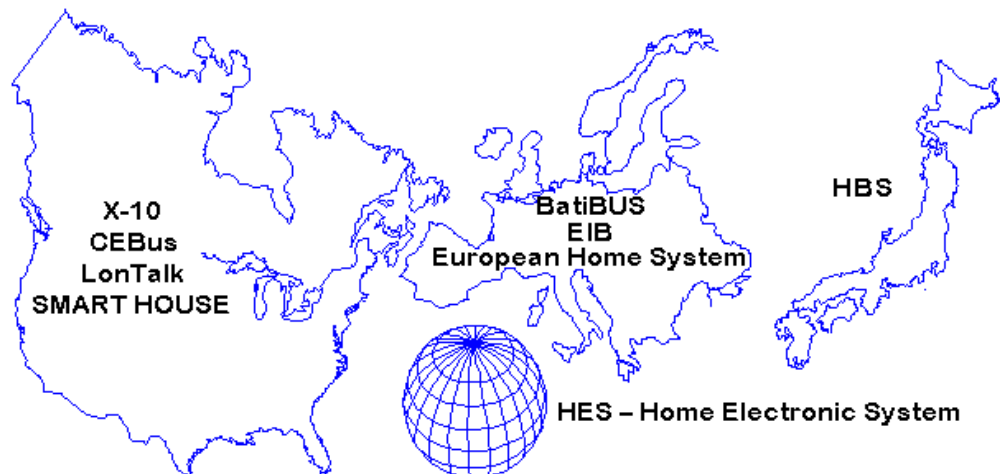


To counter this situation in Europe, the most relevant initiatives, namely BatiBUS, the European Installation Bus (EIB) and the European Home System (EHS), were brought together in order to develop a common communication protocol called Konnex. Nevertheless, due to the very slow development of this solution, many European industrial manufacturers again chose other existing solutions like Lonworks or selected wireless protocols.



However, many manufacturers have actively promoted associations that help them to define and develop solutions that guarantee interoperability of new products developed under specific solutions. This is the case with communication protocols such as OSGi and Universal Plug n Play (UPnP) that tend to follow continental lines, although Home Electronic System (HES) is being adopted internationally.

Figure 1: Distribution of home automation communication protocols



Appendix III has more information about home automation communication protocols.

Home Entertainment

Residential Gateways provide varying degrees of home entertainment, but as the availability of broadband Internet and the move towards digitization of content progresses, entertainment is an essential component for the connected home.

IPTV & VOD

Until recently traditional broadcast television has been dominated by terrestrial, cable and satellite distribution. However, new direct-to-home distribution methods are rapidly emerging via the delivery of video services over Digital Subscriber Line (DSL) and Fibre to the Home (FTTH) networks. New advanced coding technologies such as MPEG-4 open the possibility for the delivery of high-quality TV over bandwidth constrained broadband networks such as ADSL.



Residential gateways contribute significantly to home entertainment through the following value adding functions:

- Enhanced broadcast TV: With broadband Internet connectivity, service providers can offer a wider range of “traditional” broadcast television content through applications such as IPTV. This type of TV content is a normal part of most people’s lives and it is well suited for live events and for news coverage.
- Electronic Program Guide (EPG): Complimenting the standard TV offering, this service provides up to date information about the different channels and programs that are being showed at specific times. Useful features include detailed movie and program reviews or alert services where the user is notified when a selected event is starting.
- Quiz and vote applications: Users can answer multiple-choice type of questions or vote on their favorite in a program by using a remote control.
- Video on Demand: “On-demand” services are becoming increasingly important in the video entertainment area because they allow users to watch the movies of their choice at a time that suits them. Movie rental stores have traditionally handled this need, but now broadband networks can offer the same service in an even more convenient way: simply order and watch the movie direct from your living room.

Digital Media Adaptors

As the amount of stored digital content in the home increases, the PC is becoming the natural entertainment hub for digital images, audio and video in the connected home. Digital media adaptors enable streaming of media from the PC to TV-centric devices around the home.



UPnP automatic detection mechanisms or network shared files, digital media adapters receive content stored on the PC or an alternative server device, and provide additional user interfaces for browsing entertainment content available on the network. Multimedia residential gateways can be enabled to deliver private content such as:

- Digital video files: MPEG-1, MPEG-2, MPEG-4, DivX, Xvid, WMV9, H.264, DV (Real-time bit rate translating of media streams for QoS purposes)
- Digital audio files :LPCM, WAV, AU, MP3, AAC, WMA, OGG (ASX / M3U play list formats and ID3 tags)
- Digital photo files: JPEG, JPEG 2000, TIFF, BMP, PNG and GIF (Photo slideshows, zoom and rotation)
- Internet Radio: Access to Premium Content Delivery Protocols and DRMs such as Real Rhapsody and thousands of free international Internet radio stations

TV Web Browsers

TV Web browsers fulfill a dual function in that they enable access to connected entertainment content via IP networks (any World Wide Web page) while also facilitating a Graphical User Interface for controlling and manipulating all the functions available on the residential gateway.

Various sources of content are supported by web browsers including media existing within the home network, media from USB connected peripherals or storage devices, and online media streamed from the Internet over broadband IP.



Analogue Distribution

Many households currently receive audio/video signals over an analogue distribution system. Some of these have a star-wired feed from a splitter or distribution amplifier in the attic and others distribute a feed from the living room so as to be able to include additional local sources for multimedia residential gateway operation.

The cost of installing UHF distribution is not trivial; it is difficult to install coaxial cable neatly and may not be practical in temporary or rented accommodation. As an alternative to wired distribution, systems that modulate the analogue PAL signal to transmit in the unlicensed 2.4GHz have become popular. Such systems should continue to work after digital distribution becomes mainstream provided the source signals continue to be available. Analogue distribution is likely to remain the dominant method for receiving audio and video in outlying locations for many years.

Digital Distribution

Home networks for PC-based devices in the home are commonplace in PC-literate families and are growing rapidly with the emergence of WiFi systems. The extension of these systems to permit video streaming is receiving massive development effort worldwide in association with manufacturer's plans to produce media centre devices offering storage and replay of music, digital still pictures and video recordings.



Distribution over Ethernet using an appropriate physical layer connection seems reasonably assured and is likely to impact the market for CE products over the next few years. As momentum behind online distribution of content mounts, both CE manufacturers and the major content providers are developing new business models to ensure that digital rights management issues are resolved (it remains to be seen whether or not this is satisfactory to the consumer!).

In the design of future products, there are strong arguments to consider connectivity in a local cluster separately from any inter-room network. For these applications, IEEE1394 (Firewire) may still find a place but there is evidence that USB 2.0 will become predominant for many applications.

Hardware: The VIA Eden Platform



Finding the right hardware platform for the digital home is a major challenge as it requires a unique combination of a rich feature set, small footprint, ultra low power consumption and x86 compatibility with the wealth of existing software and hardware for the connected home. These features enable excellent performance from attractive, stylish devices that compliment the ambiance of the home while delivering economical and reliable 24/7 operation.

X86 Architecture is Key

Residential gateways not only have to communicate with all the other devices in the connected home, they are the link to the outside world through the Internet and a growing range of other standard x86 connectivity options, such as home networks, USB storage devices and WiFi. Standard x86 processors and chipsets are not intended for the designer styled enclosures that are essential in home automation systems, but rather for large tower style cases with multiple whirring cooling fans. With its native x86 design and compatibility with PC hardware and software, the fanless VIA Eden Platform is ideally suited for residential gateway applications.

Ultra Low Power Consumption

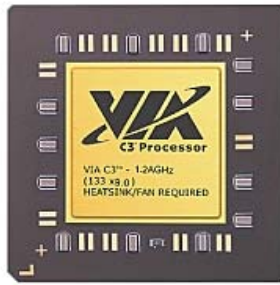
The power efficient VIA Eden Platform is designed for fanless operation in compact designer styled systems that can operate with ultimate reliability 24 hours a day, 7 days a week. Standard x86 processors and chipsets require bulky tower PC cases with multiple cooling fans that are not ideal for residential gateway systems, which should ideally be small and quiet. With the VIA Eden Platform, residential gateway vendors can reduce the number of moving parts in the system, resulting in higher levels of reliability with quiet, ergonomic operation for discerning consumers.

Miniaturization

Minimizing the footprint of processor platforms is an important aspect for residential gateways because it enables greater design flexibility for stylish, elegant devices. The VIA Eden Platform not only helps to reduce the space required by the silicon components on the board through market leading chip packages, it also helps to reduce the amount of space required by power supplies and coolers in the system due to its ultra low power consumption.



The figure below shows how VIA has reduced the footprint of VIA Eden processors through market leading miniaturization technologies in chip packaging.



50mm x 50mm

CPGA Package



35mm x 35mm

EBGA Package



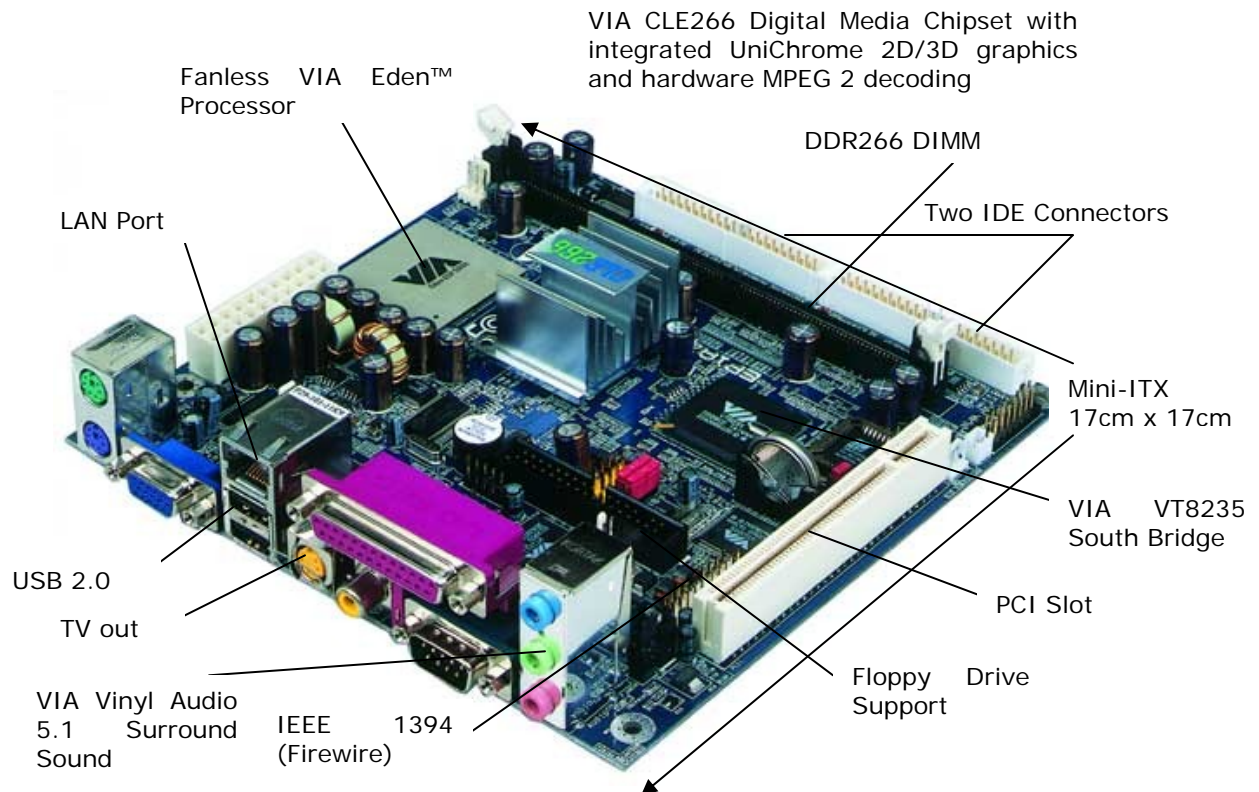
15mm x 15mm

nanoBGA Package

Total Platform from One Vendor

Over the years, VIA has expanded its product portfolio to include chipsets, power efficient x86 processors, advanced connectivity, multimedia, networking and storage silicon, and complete mainboard solutions. This allows system builders to reduce the time and costs involved with R&D development for new devices, and helps drive system innovation in the embedded and home automation markets.

Total Platform from One Vendor: VIA EPIA ME6000 Mini-ITX Mainboard Featuring the VIA Eden Platform



More information about the VIA Eden Platform is available from the [VIA Eden ESP processor](#) and [VIA CLE266 chipset](#) web pages.



The HogarDigital Residential Gateway

Leading home automation specialists, HogarDigital, provide a comprehensive package that includes hardware, software and compatibility with 3rd party service providers for advanced Residential Gateways. Based on the VIA Eden Platform, HogarDigital systems can combine various additional hardware through standard connectivity and expansion options such as PCI slots, USB2.0 and IEEE1394 (Firewire) ports.



HogarDigital Service Packages operate over a WiFi ADSL router (firewall plus parental control) with OSGi Automation services that include lighting control, electro valves, shades and blinds and acclimatization together with security services such as non-intrusive security, technical security, video vigilance, tele-assistance, access control and presence simulation. The package also provides Web-TV and other entertainment services such as the ability to share MPEG 4 and MPEG 2 videos with remote TVs and PCs, Internet radio and digital music reproduction.

However, it is the HogarDigital Embedded Webserver Remote capability that really sets it apart from other home automation systems because it affords users comprehensive control of their home from any place with Internet or mobile phone coverage. This is done with a mobile phone (SMS, WAP, iMODE, XHTML) or remote browser such as a PDA (from dynamic IP addressing SSL portal).

Entertainment



Instant Messenger

Using any display device, such as a television or a PC screen, the user can connect to the Internet and use the Microsoft Messenger utility.



Internet Radio

Users can receive any online radio station and share the content with HiFis and other audio output devices in the home network.



Web Navigator

Allows excellent Internet surfing with support for W3C and Flash formats.



Pay Per View – VOD

HogarDigital service packages can be used with third party online content providers to view and pay for streaming digital content.



Music Sharing

Users can share music play lists and files in various formats between devices on the home network.



Digital Media Server

HogarDigital allows users to share wide screen video content using MPEG2 and MPEG4 formats through http and rstp.



Comfort



Lighting Control

Allows users to control individual or groups of lights and alter brightness.



Shades and Blinds

The user can control window shades and blinds according to the desired privacy and luminosity.



Internet Remote Control

Allows integration into existing control networks, through configuration with X10, EIB, LONWORKS, E-Domo, POWERCODE and other networks, to enable remote operation and control from any Internet enabled device.



Electrovalves

Allows the users to regulate gas and water services remotely.



Acclimatization

Allows the user to control airflow and temperature through specific zones in the home.

Security



Video Vigilance

Together with IP cameras, such as USB webcams, users can keep an eye on the home from any Internet enabled device.



Access Control

Provides alerts and monitoring of open doors and windows. HogarDigital service packages can also be configured to open and close doors when using a special door lock.



Presence Simulation

Simulates human presence in the home by random operation of home control devices in order to prevent intrusions.



Technical Security

Sensors detect fire, gas or water leaks and can cut supply while also alerting users, neighbors and emergency services by SMS.



Tele-Assistance

Assists disabled and old people by allowing them to contact family or emergency personnel by SMS in times of need.



Consumption Indicator

Indicates consumption levels for gas, water and electricity and identifies leaks and supply issues. It can also calculate consumption levels and estimated costs for services.



Intrusion alerts

Sensors installed in the house detect movement and notify the user or the security company by SMS.

Communications



Broadband Internet

Enables access to high-speed Internet through cable modem, ADSL or Ethernet connections and allows for static or dynamic IP addresses.



Home Network

Automatically or manually controls and assigns names and IP address of all devices in the home network.



Local Network Security

Firewall and network intrusion detection services that can be customized to the desired security level.



Parental Control

Users can block access to adult content or gambling websites.



Premium Services

Provides unified invoicing and list of services, applications and content contracted to the Services Center (telemanagement datacenter of all the gateways) and ability to update, stop, uninstall or subscribe to new services or applications offered by any OSGi operator.

Conclusion

Home automation systems have the daunting task of having to be compatible with dozens of communication protocols and systems that have been specifically developed for various regions and applications. Additionally, these systems need to be able to connect to the World Wide Web in order to provide remote access and control of devices in the home, in short, they require an x86 compatible gateway. Residential gateways have unique processor platform requirements in that they require x86 compatibility with consumer electronics reliability and design flexibility.

The HogarDigital Service Package provides a comprehensive solution for residential gateways because it provides complete compatibility between the devices in the connected home and the vast resources of the Internet. Key to the attractive design and reliable operation of the HogarDigital Package, the fanless VIA Eden Platform provides the most suitable x86 solution for residential gateways. With its ultra low power consumption and unmatched levels of integration, the VIA Eden Platform is ideally positioned for stylish, quiet and reliable connected home devices.



Appendix I

Broadband Internet Gateways

SOHO Router Residential Gateways

SOHO Routers are consumer communication devices that are connected to an external broadband modem (Cable or DSL modem) via Ethernet or USB and enable Internet connectivity sharing between a number of networked systems. It is essentially a two box solution (SOHO Router works in conjunction with a Cable or DSL broadband modem).

Cable Router Residential Gateways

Cable Routers (also called cable residential gateways) are typically one box solutions that combine a DOCSIS cable modem device with a SOHO router device. Cable routers facilitate cable broadband Internet sharing, VPN and other applications.

Cable MTA Residential Gateways

Cable MTA (Multimedia Terminal Adaptor) residential gateway devices provide Voice and IP Video functionality over cable broadband and are based on the PacketCable Standards from Cablelabs. There are two flavors of cable MTA:

- a. The EMTA (Embedded Multimedia Terminal Adapter) is a one-box solution that provides both Voice Over Cable and High Speed Data Over Cable Broadband. A DOCSIS 1.1 Cable modem providing Voice Over Cable functionality is an example of an EMTA.
- b. The SMTA (Standalone Multimedia Terminal Adapter) is a two-box solution that provides Voice Over Cable functionality by being externally connected to a DOCSIS 1.1 cable modem through the USB or Ethernet port.

DSL Residential gateway

A DSL IAD (Integrated Access Device) is a single box consumer premises solution, providing for simultaneous high speed Internet data access and toll quality voice calls over DSL broadband connection. DSL IADs can additionally incorporate SOHO Router functionality (hence called a DSL Router or DSL residential gateway) and provide for Internet connection sharing, VPN and Wireless LAN access point benefits to the consumer.

DSL broadband is based on the ATM technology. Data over DSL is transported as AAL5 cells and IP packets are encapsulated in the AAL5 cells. Voice calls (called derived voice lines) can be made over DSL broadband in two ways :

- a. Voice Over DSL: Voice is transported as AAL2 cells. BLES (Broadband Loop Emulation Service) spec TR-036 of DSL forum defines the guidelines.
- b. Voice Over IP Over DSL: Voice is transported as IP packets (RTP Packets) which are encapsulated in AAL5 cells. MGCP is commonly used for signaling. However H.323 and SIP signaling are also used based on the investment decisions of TELCO.

DVB/MHP Residential Gateways

Digital Settop Boxes (STB) are consumer devices that connected to a TV set to provide services like Digital High Definition Television, Content Decryption (based on



consumer subscription of pay channels), Personal Video Recording, Electronic Programming Guides etc... They can also provide web browsing and interactive television features. STBs get content feed regarding channel programming from digital cable, terrestrial or satellite broadcasts and the return path for the interactive TV up-clicks could be either through a dialup or broadband modem which could be built-in or connected externally.

Digital Settop Boxes are fast evolving in to Settop Box residential gateways, where they cater for the data, voice and entertainment connectivity needs of the entire household and do not limit connectivity to the TV set alone. This is attributed to the factors described below:

- a. Consumers demand to see media content or programming and streaming audio/video on multiple TV sets or other display devices in the home
- b. Advances in home networking technologies (especially Wireless LAN) that make it easier to share digital content within the home
- c. Increased availability of multiple PCs, information appliances (like PDAs, Web Pads etc.), intelligent/smart home devices and increase of telecommuters
- d. Growth of broadband Internet access to homes

In addition to the traditional functionality of digital HDTV, Content Decryption, Pay Per View, PVR, EPG, and Interactive TV, STB residential gateways provide the following additional consumer benefits:

- a. Broadband connectivity to the multiple PCs, and information appliances in the home
- b. High speed wireless LAN access to anywhere in the house, including in-home file/print/device sharing
- c. Firewall security, parental protection and VPN connectivity
- d. Show content programming (directly received through satellite, cable, terrestrial or stored in the STB PVR hard disk) on to multiple TVs and display devices located in various rooms of the home
- e. Streaming content and IP Video on Demand (received through broadband Internet connectivity or stored in the STB PVR hard disk) on to multiple TVs and display devices located in various rooms of the house
- f. Enables remote health monitoring and security surveillance applications

Appendix II

Home Networking

Broadband home networks can operate over various physical media. These can be organized into three broad groups: structured wiring, existing wiring, and wireless.

- Structured wiring requires installing new cabling in the walls. Both the cabling (typically unshielded twisted pair [UTP] or fiber) and its installation are defined by standards.
- Existing wiring makes use of electrical, telephone, or coax wiring already installed in the walls.
- Wireless avoids the use of wires by transmitting through the air.



STRUCTURED WIRING TECHNOLOGIES



Structured wiring provides high bandwidth and excellent security. To handle the full range of current applications, a complete installation today requires several types of cabling, including UTP for telephone and data, and coax for video. Fast Ethernet at 100 Mb/s over UTP is widely used for data applications. While it has sufficient bandwidth for video, it presently does not include QoS support. As HD video moves into homes, many believe that a "home backbone"

network based on structured wiring will be required to interconnect sections of the home. The Electronics Industry Association (EIA) and CEA are developing the R-7.4 VHN Home Network Standard for this purpose.



EXISTING WIRING TECHNOLOGIES

Since structured wiring is quite expensive to install in an existing home, many companies are developing technologies based on the existing wiring in the walls of the home:

- Phone line technologies use existing telephone wiring. The Home Phone line Networking Alliance (HomePNA; <http://www.homepna.org>) has defined a 2.0 specification at about 10 Mb/s (the earlier 1.1 specification was about 2 Mb/s). Proprietary technologies operate at much higher speeds and are in contention for the 3.0 specification.
- Power line technologies use the existing electrical wiring. There are many competing technologies. The Home Plug Powerline Alliance (<http://www.homeplug.org>) has brought several vendors together, and CEA R7.3 is working to define standards (http://www.ce.org/Technology_and_Standards/Technology_and_Standards_Committees.asp).
- Coax technologies use coax cabling. A HomeCable Network Alliance (HomeCNA; <http://www.homecna.org>) is working to define a specification.



WIRELESS NETWORKING

Wireless networking is perhaps the most attractive approach for the home, since it avoids the cost of adding new wiring and the challenges of using existing wiring. There are many competing technologies and associated standards and advocacy groups associated with wireless networking:

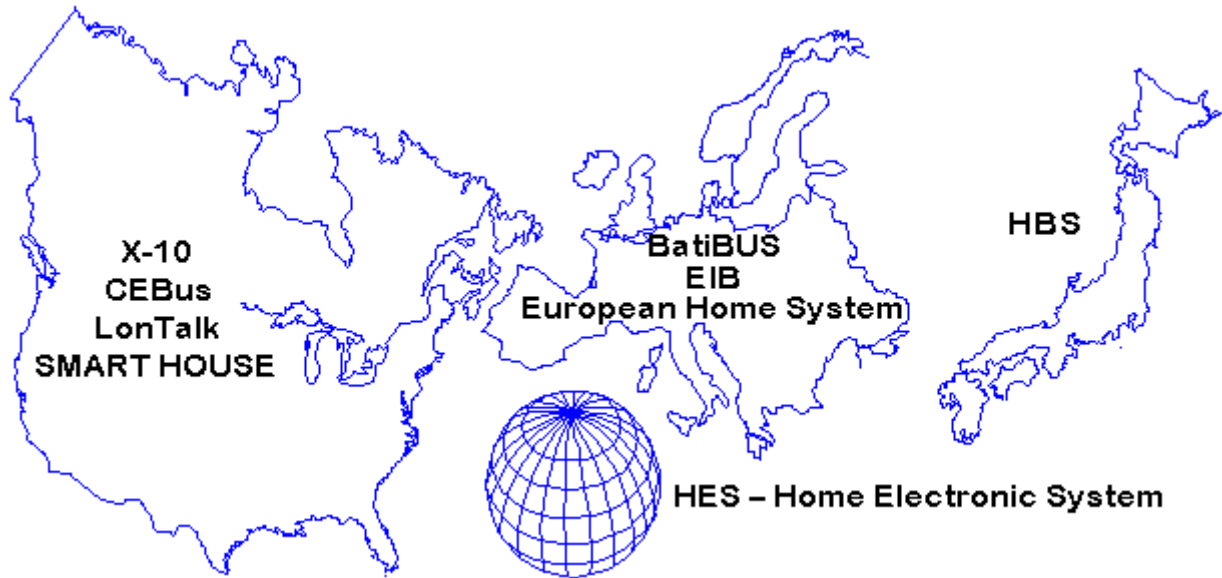
- IEEE 802.11 (<http://standards.ieee.org/getieee802/802.11.html>) is a family of evolving standards, originally designed for enterprise networking and is now moving into the home. 802.11b at 2.4 GHz is the oldest version with 802.11a at 5 GHz and 802.11g at 2.4 GHz are the future.
- HomeRF (<http://homerf.org>) is a family of wireless LAN technologies specifically designed for the home. While the current generation of HomeRF is incompatible with 802.11b, the group appears to be favoring 802.11a as the next generation.
- Bluetooth (<http://www.bluetooth.com>) was designed for short-range personal networking and is being extended for longer range.
- HiperLAN (<http://www.hiperlan2.com>) is a family of ETSI standards for wireless LANs. These are similar to the 802.11 family but include QoS and support asynchronous transfer mode (ATM) as well as Ethernet.
- Ultra wideband (<http://www.palowireless.com/uwb>) is based on low-power spread spectrum.



Appendix III

Home Automation Communication Protocols

HES



The Home Electronic System (HES) is the name of the international standards committee officially designated as ISO/IEC JTC1/SC25/WG1 that is working in the implementation of ISO/IEC 15045 (HomeGate), the international standard for the residential gateway. It is an open voluntary standardized system for the delivery of broadband services to the home, and for the interconnection and interoperation of a wide array of home networks, systems, and products. HomeGate, as part of the HES, offers a coherent set of standards and technical reports that deal with communication between the many electronic products and appliances found in the home. Such products serve a vast array of functions including entertainment, information, communication, safety, security, comfort, convenience, energy efficiency, lighting and environmental control. HES is intended to establish, as far as possible, a basis of global compatibility, interoperability, and interoperation between such products and systems.

X10

X10 is one of the oldest protocols for home automation applications. X10 technology is a communications standard for sending control signals to home automation devices via the power line (120 V or 220 V, at 50 Hz or 60 Hz). Engineers in Pico Electronics Ltd developed it between 1976 and 1978.



X10 is a standard protocol, which does not require any extra cables. Several vendors of automation and security devices worldwide have adopted this kind of transmission, thus making all these devices compatible with one another.

Although the main market for X10 is still the United States, X10 products are also present in Europe, Asia, Africa, Latin America and Oceania.



The main design idea in X10 is that devices can interoperate with one another; thus, with X10 it is possible to control lights and virtually any other device from any room in the house without the need for any extra cabling.

X10 can be considered the most affordable technology nowadays for deploying a not very complex home automation installation during a time of major change in home entertainment equipment and services. Many of the new technologies could offer important drivers to consumer take-up of digital that would speed switchover if the timetable can be confirmed soon, or could, conversely, provide a significant impediment if the new technologies continue to be introduced with analogue receivers and result in a major delay in reaching conditions where switchover is possible. For example, it has been argued in 7.4.2 that a trial of HDTV would provide a potent illustration to consumers of the advantages of switchover, in addition to the important objective of clarifying standards. It is therefore vital that the industry and particularly CE manufacturers are given clear guidance as soon as possible on the timetable for cessation of analogue transmissions and can plan accordingly. The requirements for spectrum for handheld and mobile services, and for high definition, need to be taken into account in planning the post-switchover use of spectrum.

EIB

The European Installation Bus (EIB) was designed to be used as a management system for the electric installation in a building. It is a home automation system developed within the European Union, aimed to counteract the imports of similar products from Japan and USA, where these technologies have evolved earlier than in Europe.



The EIB standard has been proposed by the EIBA (European Installation Bus Association). The EIBA is the organization, which aggregates European electric installation enterprises to impulse the development of building systems and offer a unique and highly dependable system in the European market.

The goals in EIB are the monitoring and control of systems such as lighting, heating, air conditioning, ventilation, blinds and alarms within a building.

BATIBUS

The BatiBus bus is an open protocol developed by Merlin Gerin, Airelec, EDF and Ladis&Gyr, which founded in 1989 the BatiBus Club International (BCI). This protocol is a standard in France (NFC 46620 and subsequent sections); it is also a standard in Europe (CENELEC) and worldwide (ISO/IECJTC 1 SC25).



EHS

Sponsored by the European Commission, the European industry made an attempt in 1984 to create a technology, which would allow the massive deployment of home automation in the residential market. As a result of this effort, the EHS (European Home System) specification came out in 1992.



The EHSA (EHS Association) [EHSA] is in charge of creating initiatives for increasing the usage of this technology in European homes. Besides, it works on the evolution



and technical improvement of EHS, as well as the compatibility between products with an EHS interface.

The most important European home appliance vendors, power utilities, telecommunication companies and electric equipment vendors have been involved in EHS since its inception. The idea was the creation of an open protocol to allow covering the interconnection needs of the products from all vendors and service providers.

EHS was thought to cover the automation needs of the majority of European homes, whose owners cannot afford to use more powerful (and more expensive) systems like LonWorks, EIB or BatiBus due to the specialized handwork required for their installation. Given its features, EHS can offer services like those provided by other protocols from USA and Japan, reaching beyond X10.

KONNEX

Konnex Association (KNX) [KNX] is the new name for an association between manufactures, service providers and other interested partners. It is the result from the pooling of resources of the BatiBus Club International (BCI), European Installation Bus Association (EIBA) and the European Home Systems Association (EHSA) into a common organization.



In spring 1996 EHSA (EHS Association), BCI (BatiBus Club International) and EIBA (European Installation Bus Association) created a forum to debate the issues in which all three partners were interested. Committees were created for technical, marketing and standardization aspects, with the goal of reaching a convergence of the three systems.

The goal of this association is to create a standard for home automation that covers the needs of European residential and professional installations. This standard is to be followed by practically the whole market, so that equipment from different vendors can work together, and even cooperate, without interfering with each other. This new standard would help to:

- Increase the use of home automation buses in areas such as climate control and HVAC
- Improve the capabilities of several physical communication media, mainly RF
- Introduce new working modes, which allow a Plug&Play approach for many common devices in a home
- Connect service providers such as telecommunication companies and power utilities, for fostering home remote management and home automation

In summary, the goal is to combine EIB, EHS and BatiBus technologies to create a unique European standard able to compete in quality, functionality and affordability with other similar systems from the USA.

ECHONET

ECHONET is an abbreviation for Energy Conservation & Homecare Network. This term also means a network for realizing energy conservation and home care as well as an answer to a call or a response, from the word “echo”.

Clearly, the main goal of ECHONET is environmental conservation, reducing CO2 emissions and consequently energy consumption, including also reduction of health care costs and nursing care, as society grows older.



But this also is easily related to the rapid advances in data and communications infrastructure, in the form of high-speed, high-bandwidth communications and multimedia capabilities, making it easier than ever for households to connect to the outside world via such media as cable TV and the Internet.

These bring us to the conclusion that both issues, environmental conservation and rapid advances in data and communications, can be combined to provide in-home communication infrastructures.

This network will enable the interconnection and systematic operation of a wide assortment of home appliances and controllers from different manufacturers. In addition to being more energy efficient, homes featuring such networks will be safer, more comfortable, more user-friendly, and more environmentally sound and will be ready to meet the challenges of energy conservation, the aging of society, and home nursing care.

ECHONET is in some ways the evolution of HBS (Home Bus System) standard, home automation system developed by Japanese manufacturers and failed to achieve significant penetration in ordinary households. Utilizing the results and the experience of HBS development, ECHONET provides the base technology for the development of next-generation home network systems capable of responding to the changes in the social infrastructure. ECHONET is developing the following technologies:

- A communications protocol for a reliable, low-cost home network that requires no new wiring and can be installed in existing homes
- Multi-vendor-compatible home networking equipment
- System models for use by individual vendors to facilitate development of application systems
- Communications middleware and development support tools to mitigate the burden of development equipment
- Application service-compatible middleware to facilitate development of applications required for energy conservation

CEBUS

Based on the CEBus standard, Intellon produces products which can be used to provide control capabilities to home networks. The products consist of two fundamental components - a transceiver and a micro controller. The transceiver implements spread spectrum technology and the controller to run the protocol. The CEBus standard is an open standard that provides separate physical layer specifications for communication on power lines and other media.



Data packets are transmitted by the transceiver at about 10 Kilobits per second (Kbps), using spread spectrum technology. The CEBus protocol uses a peer-to-peer communications model so that any node on the network has access to the media at any time. Similar to Ethernet, it uses a Carrier Sense Multiple Access/Collision Detection and Resolution (CSMA/CD) protocol to avoid data collisions. Basically, this Media Access Control (MAC) protocol requires a network node to wait until the line is clear, which means that no other packet is being transmitted before it can send a packet.

In the upper layer, CEBus includes a common application language (CAL) that allows devices to exchange commands and status requests. It defines a common command syntax and vocabulary to do this. CAL defines various electronic device functional sub-units called contexts. And each context is further divided into objects, which represent various control functions of the context. Objects are further defined by a set of instance variables that specify the operation of the function of the object. By utilizing the CAL specification, Intellon ensures their products can communicate with other CAL compliant devices.

Intellon offers products ranging from chip sets to board solutions, depending on the level of integration the manufacturer wants to perform on their own. But the cost issues have made Intellon chips less affordable and thus they are not widely used as X10 devices.

LONWORKS

Echelon, like Intellon, provides a peer-to-peer communication protocol, implementing Carrier Sense Multiple Access (CSMA) techniques. It makes efforts to provide a whole set of control networking technology, with its Neuron chip, LonTalk protocol and LONWorks Network Service. Echelon offers a 10 Kbps power line chip based on spread spectrum technology. Echelon also offers a sophisticated proprietary MAC protocol embedded in their Neuron chip, providing the peer-to-peer networking layer. The LONWorks has just been passed ANSI/EIA standards process and now can be known as ANSI/EIA 701.9-A-1999.



With LONWORKS, control networking technology goes beyond simply being a communication protocol. It provides a complete platform on which to build control systems. The LonTalk protocol, an open and international standard designed specifically for the needs of control, is at the heart of LONWORKS networks. Neuron Chip in LONWorks family includes an implementation of the LonTalk protocol along with other built-in features to provide a complete system-on-a-chip solution for control devices. Inside this chip, LonTalk protocol supports many communication



media including, twisted pair, power line, fiber optics, coaxial cable, radio frequency, and infrared. Good news is that Echelon's proprietary protocol strategy changed recently when they opened up their Neuron protocol, allowing it to interface with third-party power line transceivers.

Above these, LONWORKS Network Services (LNS) architecture is a powerful network operating system, which provides an object-oriented method to connect networked control devices. It provides a unified API system for developing tools for installing, configuring, and maintaining, monitoring and controlling LONWORKS control networks. LNS clients can run on any platform (PC, MAC, UNIX, embedded, etc.). And LNS Server supports both LONTALK and TCP/IP protocols at the transport layer.

ZIGBEE

ZigBee is the only standards-based technology designed to address the unique needs of low-cost, low-power, wireless sensor networks for remote monitoring, home control, and building automation network applications in the industrial and consumer markets. In a recent study by West Technology Research Solutions L.L.C. (WTRS), analysts estimate that in the not too distant future, it will be common to find as many as 100 ZigBee chips around the house and devices ranging from light switches to home security systems to landscaping control.



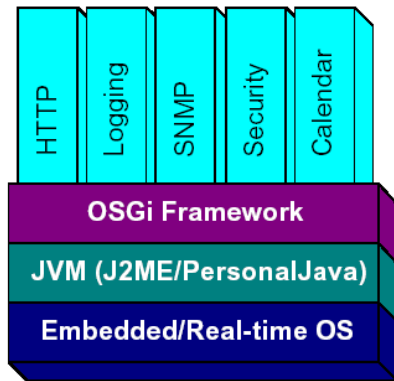
The ZigBee Alliance is an association of companies working together to create a very low-cost, very low power consumption, two-way, wireless communications standard. This wireless communications solution will be embedded in consumer electronics, home and building automation, industrial controls, PC peripherals, medical sensor applications, toys and games.

IEEE 802.15.4 is the low data rate wireless PAN (Personal Area Network) standards Task Group of IEEE. This group is focused on documenting the lower two layers of the protocol stack (physical and data link). IEEE and the ZigBee Alliance have been working closely together to specify the entire protocol stack.

Convergence Technologies

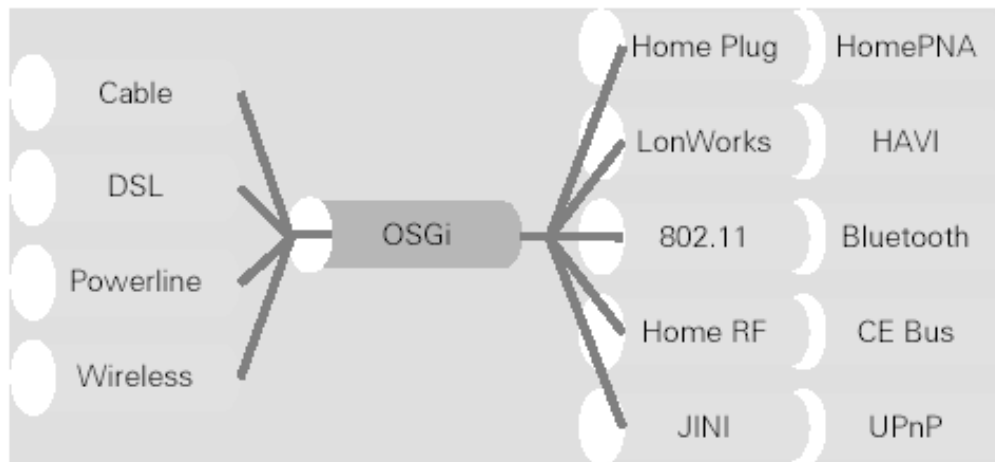
OSGi

The OSGi Alliance Service Platform helps to improve time-to-market and reduce costs of manufacturing and development, and as such enables new & exciting services and applications for networked devices.



OSGi specifications are so widely applicable because it is a small layer that allows multiple, Java™ based, components to efficiently cooperate in a single Java Virtual Machine (JVM). It provides an extensive security model so that components can run in a shielded environment. However, with the proper permissions, components can reuse and cooperate with each other, unlike other Java application environments. The OSGi Framework provides an extensive array of mechanisms to make this cooperation possible and secure.

The presence of OSGi based middleware in many different industries is creating a large software market for OSGi software components. The rigid definition of the OSGi Service Platform enables components that can run on a variety of devices, from very small to very big.



Founded in March 1999, the OSGi™ Alliance specifies, creates, advances, and promotes industry wide adoption of an open service delivery and management platform. The OSGi Alliance serves as the focal point for a collaborative ecosystem of service providers, developers, manufacturers and consumers.

UPnP

UPnP™ technology is all about making home networking simple and affordable for users so that the connected home experience can become mainstream for the industry. UPnP™ architecture offers pervasive peer-to-peer network connectivity for PCs of all form factors, intelligent appliances, and wireless devices. UPnP™ architecture leverages TCP/IP and the Web to enable seamless proximity networking in addition to control and data transfer among networked devices in the home, office, and everywhere in between. UPnP™ technology can be supported on essentially any operating system and works with virtually any type of physical networking media - wired or wireless - providing maximum user and developer choice while being extremely economical.

UPnP specifications have been standardized by specific technical working committees and include: Internet Gateway Device, Printer Device, Print Basic Service, Scanner, Basic Device ,HVAC ,WLAN Access Point Device , Device Security, Security Console and Lighting Controls.

The UPnP Audio Visual (AV) specification therefore defines a set of UPnP device and service templates that specifically target consumer electronics systems such as TVs, VCRs, DVD players, stereos and MP3 players, in addition to PCs. The UPnP AV architecture defines three main logical entities: a Media Server, a Media Renderer, and a Control Point.

- The Media Server has access to entertainment content and can send that content to other UPnP AV devices via the network.
- The Media Renderer is able to receive external content from the network and render it on its local hardware.
- The AV Control Point coordinates the operation of the Media Server and Media Renderer.

Since the AV architecture can accommodate various transfer protocols and content formats, Media Servers and Media Renderers can transfer the desired content using any transfer protocols and data format that they *both* support. As part of its set-up and configuration responsibilities, the Control Point must identify and select the protocol and format to be used. Although the architecture defines three logical entities, a physical device may contain any combination of them, e.g. many implementations of renderers are likely to include a control point so that the user can control the operation using the same device that is rendering the content.

Appendix IV

Challenges for TV Web Browser Displays

Displaying typical web content on a television and other low-resolution screens presents a number of challenging issues for an embedded browser; browsers should be able to display Internet content on any TV screen, taking advantage of widescreen (16:9) and high definition television formats if supported by the hardware. The display engine should also use advanced rendering and color correction techniques to create a flicker free display with legible text at any size.

Web Content and User Interface Authoring Formats include:

- HTML 4.01
- -2 and CSS-TV
- CSS
- DOM-2
- XHTML and XML
- DHTML
- JavaScript 1.5
- I-Frames
- 3.0 128-bit encryption for secure online transactions
- SSL
- Macromedia Flash compatibility
- JPEG, GIF, and PNG with 8-bit alpha mask
- MP3, Wave (WAV) and AU